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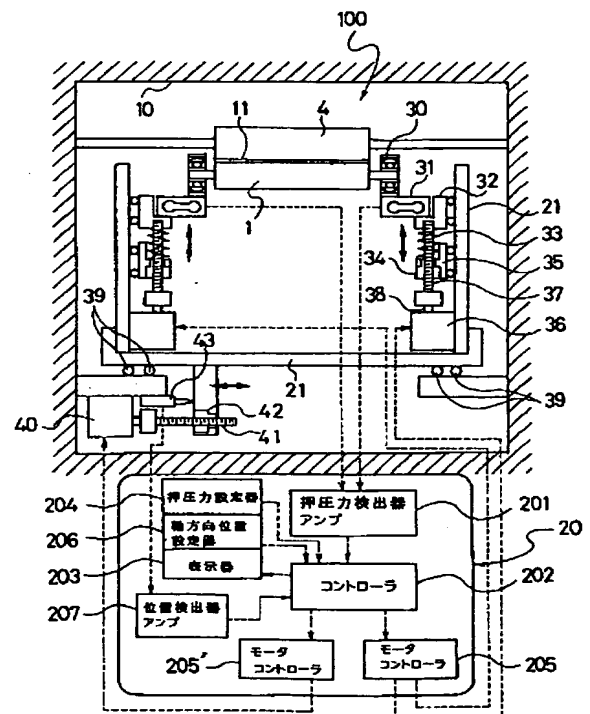
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(54) 【発明の名称】 真空蒸着装置

(57) 【要約】

【課題】 転写ローラや印刷ローラの押圧力調整を容易にする真空蒸着装置、印刷ローラのオイルマスクとフィルムのローラ軸方向位置との相対位置調整を容易にする真空蒸着装置を提供する。

【解決手段】 オイルマスク形成機において、転写ローラ 2 を印刷ローラ方向へ、印刷ローラ 1 をバックアップローラ方向へそれぞれ移動させる押圧駆動手段 3 3、3 4、3 5、3 6 とガイド機構 3 2 を設け、該押圧駆動手段と転写ローラ 2 および印刷ローラ 1 との間にそれぞれ押圧力検出器 3 1 を設け、押圧力検出器 3 1 の信号に基づいて押圧駆動手段の駆動量を制御する。また、印刷ローラ 1 と転写ローラ 2 の両軸端支持部を支持するフレーム 2 1 をローラ軸方向へ移動させる駆動手段 4 0、4 1 とガイド機構 3 9 を設け、フレーム 2 1 のローラ軸方向の位置を検出する変位測定器 4 3 を設け、変位測定器 4 3 の信号に基づいてフレーム 2 1 の軸方向の移動量を制御する。



## 【特許請求の範囲】

【請求項 1】 オイル転写用の転写ローラを印刷ローラに押圧し、該印刷ローラをバックアップローラに押圧し、該印刷ローラとバックアップローラとの間にフィルムを走行させて、該フィルム上に非蒸着部となるオイルマスクを形成するオイルマスク形成機を設けた真空蒸着装置において、前記転写ローラを前記印刷ローラ方向へ、前記印刷ローラを前記バックアップローラ方向へそれぞれ移動させる押圧駆動手段とガイド機構を設け、前記押圧駆動手段と前記転写ローラおよび印刷ローラとの間にそれぞれ押圧力検出器を設け、該押圧力検出器の押圧力信号に基づいて前記押圧駆動手段の駆動量を制御する制御部を設けた真空蒸着装置。

【請求項 2】 前記押圧駆動手段と前記転写ローラおよび前記印刷ローラとの間に、それぞれ圧縮弾性力を生ずる弾性体を介在させた請求項 1 に記載の真空蒸着装置。

【請求項 3】 前記転写ローラと印刷ローラの両軸端支持部を、それぞれ角度調整自在に支持した請求項 1 又は 2 に記載の真空蒸着装置。

【請求項 4】 前記印刷ローラと転写ローラの両軸端支持部をそれぞれフレームで支持し、該フレームをローラ軸方向へ移動させる駆動手段とガイド機構を設けると共に、前記フレームのローラ軸方向の位置を検出する位置検出器を設け、該位置検出器の位置信号に基づいて前記フレームの軸方向の移動量を制御する請求項 1～3 のいずれか 1 項に記載の真空蒸着装置。

【請求項 5】 オイル転写用の転写ローラを印刷ローラに押圧し、該印刷ローラをバックアップローラに押圧し、該印刷ローラとバックアップローラとの間にフィルムを走行させて、該フィルム上に非蒸着部となるオイルマスクを形成するオイルマスク形成機を設けた真空蒸着装置において、前記印刷ローラと転写ローラの両軸端支持部をそれぞれフレームで支持し、該フレームをローラ軸方向へ移動させる駆動手段とガイド機構を設けると共に、前記フレームのローラ軸方向の位置を検出する変位測定器を設け、該変位測定器の位置信号に基づいて前記フレームの軸方向の移動量を制御する制御部を設けた真空蒸着装置。

【請求項 6】 請求項 1～5 のいずれか 1 項に記載の真空蒸着装置を使用して、非蒸着部分を有する蒸着フィルムを製造する蒸着フィルムの製造方法。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は、蒸着前のフィルムにオイルマスクを形成して非蒸着部分を有する真空蒸着フィルムを製造する真空蒸着装置に関する。

## 【0002】

【従来の技術】 真空蒸着装置内で蒸着フィルムに幾何学模様の非蒸着部を形成する方法としては、物理的マスク蒸着法やオイルマスク法等があり、また蒸着後では、蒸

着フィルム上の金属をレーザーで蒸発させるレーザーマージン法等がある。これらの方法のうち、特にオイルマスク法は安価な設備で実施できるため広く使用されている。

【0003】 図 4 は、真空蒸着装置に設けられる従来のオイルマスク形成機を示す。転写ローラ 2 の表面にオイルノズル 3 から噴射したオイルを塗布し、その転写ローラ 2 を印刷ローラ 1 に押圧して、印刷ローラ表面の凸状の幾何学模様上にオイル被膜を形成し、その印刷ローラ 1 をバックアップローラ 4 に押圧した状態で、両ローラ 1、4 の間にフィルム 11 を通して、そのフィルム 11 上に幾何学模様のオイル被膜を転写するようになっている。

【0004】 上記のようにオイル被膜を転写するときの転写性を良好にするため、転写ローラ 2 を印刷ローラ 1 に対し、また印刷ローラ 1 をバックアップローラ 4 に対してそれぞれ押圧力を与えるようにしてある。その押圧機構として、印刷ローラ 1 および転写ローラ 2 の各々の軸端部に、軸と直交する方向に螺進する押しボルト 12 をボルトホルダー 13 に保持するように設けており、この押しボルト 12 を手動で回転させることにより、それぞれのローラ軸端を案内バー 14 に沿って押し込み、押圧力を発生させるようにしている。

【0005】 印刷ローラ 1 や転写ローラ 2 の押圧力の調整は、真空蒸着運転する前の大気開放状態のとき作業者が手動で押しボルト 12 を回動させて行い、その回転角度で押圧力を管理するようにしていた。しかし、高いバネ定数のローラを押しボルトで位置決めし、押圧力を付与しようとするため、適正押圧力に合わせることが非常に困難となり、実際の押圧力の定量値や押したローラが受ける軸方向の押圧力バランスは分からないため、作業者の経験や感に依存するところが多く非常に困難な作業であった。

【0006】 したがって、押しボルトの回転角度による管理には非常な熟練を要し、作業者の技術レベルにより設定押圧力が変わったり、或いは正確に設定したとしても、各ローラの温度上昇によってローラ径が膨張することにより蒸着運転中に押圧力が過大になり、最後にはローラを損傷してしまう問題を起こすことがあった。これは押しボルトで押されるローラと対向ローラとの間でバネ要素となるものがゴムローラのゴム厚み程度のものしかなく、しかもゴム硬度が高いため、非常に高いバネ定数となっていることにも原因がある。

【0007】 従来では、上記のようなトラブルが発生すると、蒸着作業を一時中断して真空蒸着装置を大気開放状態に戻し、再度押しボルトの回転角度を調整し直すように対応していた。また、印刷ローラの幾何学模様とフィルムのローラ軸方向位置との相対位置関係は高い精度を要求されるが、従来装置では蒸着運転前の大気開放状態において、印刷ローラの軸方向位置をスケールで測定

して位置合わせすることにより相対位置関係を設定していた。そして、蒸着作業の予備運転を行うことによって、フィルムとオイルマスクの相対的な位置関係を確認するようにし、この時に幾何学模様のオイルマスクとローラ軸方向位置とがずれていたり、フィルムへのオイル転写量の分布が悪い場合には、蒸着作業を一時中止し、再度手動による調整をする必要があった。

【0008】このようなオイルマスクのローラ軸方向調整を大気中で手動調整する作業には限界があり、これら作業効率の悪いことが、オイルマスク蒸着フィルムの生産効率がオイルマスクのない一般蒸着フィルムにくらべて大きく低下する原因になっていた。

【0009】

【発明が解決しようとする課題】本発明の目的は、上述した従来の問題を解決し、真空蒸着運転を中断することなく転写ローラや印刷ローラの押圧力調整を容易に実施することができる真空蒸着装置を提供することにある。本発明の他の目的は、真空蒸着作業を中断することなく印刷ローラのオイルマスクとフィルムのローラ軸方向位置との相対位置の調整を容易に実施することができる真空蒸着装置を提供することにある。

【0010】

【課題を解決するための手段】上記第1の目的を達成する本発明の真空蒸着装置は、オイル転写用の転写ローラを印刷ローラに押圧し、該印刷ローラをバックアップローラに押圧し、該印刷ローラとバックアップローラとの間にフィルムを走行させて、該フィルム上に非蒸着部となるオイルマスクを形成するオイルマスク形成機を設けた真空蒸着装置において、前記転写ローラを前記印刷ローラ方向へ、前記印刷ローラを前記バックアップローラ方向へそれぞれ移動させる押圧駆動手段とガイド機構を設け、前記押圧駆動手段と前記転写ローラおよび印刷ローラとの間にそれぞれ押圧力検出器を設け、該押圧力検出器の押圧力信号に基づいて前記押圧駆動手段の駆動量を制御する制御部を設けたことを特徴とするものである。

【0011】このように押圧力検出器の押圧力信号に基づいて押圧駆動手段の駆動量を制御するので、真空蒸着運転を中断することなく転写ローラや印刷ローラの押圧力調整を容易に実施することができるようになる。また上記第2の目的を達成する本発明の真空蒸着装置は、オイル転写用の転写ローラを印刷ローラに押圧し、該印刷ローラをバックアップローラに押圧し、該印刷ローラとバックアップローラとの間にフィルムを走行させて、該フィルム上に非蒸着部となるオイルマスクを形成するオイルマスク形成機を設けた真空蒸着装置において、前記印刷ローラと転写ローラの両軸端支持部をそれぞれフレームで支持し、該フレームをローラ軸方向へ移動させる駆動手段とガイド機構を設けると共に、前記フレームのローラ軸方向の位置を検出する変位測定器を設け、該変

位測定器の位置信号に基づいて前記フレームの軸方向の移動量を制御する制御部を設けたことを特徴とするものである。

【0012】このように位置検出器の位置信号に基づいてフレームの軸方向の移動量を制御するので、真空蒸着作業を中断することなく印刷ローラのオイルマスクとフィルムのローラ軸方向位置との相対位置の調整を容易に実施することができるようになる。さらに、本発明の真空蒸着装置によれば、押圧駆動手段の駆動量の制御やフレームの軸方向の移動量の制御を真空蒸着作業を中段することなく容易に実施することができるため、非蒸着部を有する蒸着フィルムを効率よく生産することが可能になる。

【0013】

【発明の実施の形態】図1は本発明の真空蒸着装置の全体を示し、図2は同装置におけるオイルマスク形成機の部分を示し、図3は図2のX-X矢視による断面を制御部と共に示したものである。図1に示すように、真空蒸着装置は、真空槽10の内部に巻き出しロール5をセットし、この巻き出しロール5に続いてオイルマスク形成機100を設け、続いて冷却ロール7と巻き取りロール6を設けている。冷却ロール7の下方には、アルミニウムなどの蒸着用金属棒8を加熱ポート9により蒸発させる蒸着部が設けられている。

【0014】巻き出しロール5から巻き出されたフィルム11は、オイルマスク形成機100において幾何学模様のオイルマスクを転写される。次いで冷却ロール7において、加熱ポート9で溶融蒸発した金属粒子がフィルム11のオイルマスクされた片面に密着して蒸着が施される。金属の蒸発源は特に限定されるものではなく、加熱ポート以外に従来公知のものがいずれも適用可能であり、例えばルツボ、エレクトロンビームガンなどを使用することができる。

【0015】オイルマスク形成機100は、図2に示すように、印刷ローラ1、転写ローラ2、バックアップローラ4を有し、印刷ローラ1とバックアップローラ4との間に被処理用の樹脂フィルム11を挟むようにしている。これらローラのうち転写ローラ2とバックアップローラ4とは平滑なローラ表面を有するが、印刷ローラ1は表面に幾何学模様の凸部を有している。

【0016】印刷ローラ1と転写ローラ2とは、対向する一対のプレート状のフレーム21に回転自在に支持され、かつ転写ローラ2は背面の圧縮コイルバネ33によって印刷ローラ1を押圧するようにしている。また、バックアップローラ4は真空槽10のフレームに回転自在に支持され、かつ印刷ローラ1によって押圧されるようになっている。

【0017】印刷ローラ1、転写ローラ2、バックアップローラ4は駆動のないフリーローラであり、そのため相互の押圧によりフィルム11から回転力を受け、フィ

ルム11と同じ周速で回転するようになっている。但し、これらローラはフィルムの走行速度と同じ周速になれば必ずしもフリーローラである必要はなく、駆動ローラであっても差し支えない。

【0018】転写ローラ2の下方にはオイルノズル3が設置され、温度80～180℃に加熱されたオイルを噴射あるいは蒸発によって転写ローラ2の表面に軸方向に均一に塗布するようになっている。転写ローラ2に塗布されたオイルは、回転接触によって印刷ローラ1の幾何学模様の凸部に転写される。印刷ローラ1の凸部に転写されたオイルの被膜は、バックアップローラ4との間を走行するフィルム11の表面に転写されてオイルマスクを形成する

図3は、オイルマスク形成機100において、バックアップローラ4に対する印刷ローラ1の押圧力調整機構と、フィルム11に対する印刷ローラ1の軸方向の位置調整機構との詳細を、制御部20と共に示すものである。

【0019】左右のフレーム21にそれぞれモータ36が固定され、そのモータ軸38が印刷ローラ1の方向に向けられており、制御部20のモータコントローラ205から入力する駆動信号により正逆に回転するようになっている。モータ軸38にはボールネジ軸37が連結され、そのボールネジ軸37の中間部にボールネジナット34を介して直動転がり軸受け35が連結されている。

【0020】また、ボールネジ軸37の先端部にもバカ孔を介して別の直動転がり軸受け32が支持され、上下二つの直動転がり軸受け32、35の間に圧縮コイルバネ33が介在している。さらに、ボールネジ軸37の上端に設けた直動転がり軸受け32は、ロードセル等の押圧力検出器31と球面軸受け30とを介して印刷ローラ1の軸端を支持するようにしている。

【0021】上記構成において、モータ36、ボールネジ軸37、ボールネジナット34、圧縮コイルバネ33などは、本発明の押圧駆動手段を構成し、また直動転がり軸受け32、35とこれをガイドするフレーム21の内面などは、本発明のガイド機構を構成する。押圧駆動手段におけるモータ36によりボールネジ軸37が回転し、ボールネジナット34が印刷ローラ1に近づく方向に進むと、ガイド機構の直動転がり軸受け35はフレーム21の内面をガイド面として直進し、圧縮コイルバネ33を圧縮する。この圧縮コイルバネ33の圧縮による反発弾性力により直動転がり軸受け32が押圧力検出器31を押圧し、さらに球面軸受け30を介して印刷ローラ1の軸端を押圧する。

【0022】この押圧力に対して、球面軸受け30は球面すべり接触により印刷ローラ1の軸端を角度自由に支持しているので、軸端での押圧力のこじれをなくし、ローラ軸方向に対して押圧力を分散平均化する。したがって、印刷ローラ1はバックアップローラ4との間に挟持

するフィルム11に対してローラ軸方向に均一な押圧力を与えることができる。

【0023】押圧力の検出は押圧力検出器31によりなされる。押圧力検出器31が検知した押圧力信号は真空槽10の外側に設置した制御部20内の押圧力検出器アンプ201に送られ、アンプ201は信号を増幅してコントローラ202へ送る。さらに押圧力信号はコントローラ202から表示器203に送られて表示されるので、作業者は常にこれをモニターすることができるようになっている。

【0024】また、作業者は予め押圧力設定器204に任意の設定押圧力を入力しておくことにより、その押圧力設定信号がコントローラ202に送信される。コントローラ202は、押圧力設定信号と押圧力検出器31で検知された実際の押圧力信号との差を演算し、その差をフィードバック信号としてモータコントローラ205へ発信することによりモータ36を駆動させ、演算差が0に近くなったときフィードバック信号が停止され、モータ36が停止するようになっている。したがって、印刷ローラ1の軸端には常に設定押圧力を適正に負荷することができる。

【0025】さらに、本発明のオイルマスク形成機100では、フレーム21が真空槽10のフレームに直動転がり軸受け39を介して支持され、印刷ローラ1の軸方向へ移動可能になっている。真空槽10のフレームにモータ40が支持され、そのモータ軸端にボールネジ軸41が連結され、そのボールネジ軸41に螺合させたボールネジナット42がフレーム21に連結するようになっている。また、真空槽10のフレームに変位測定器43が設けられ、この変位測定器43が印刷ローラ1の軸方向に対するフレーム21の位置を検出するようになっている。

【0026】上記構成において、モータ40、ボールネジ軸41、ボールネジナット42などは、本発明の駆動手段を構成し、また直動転がり軸受け39や真空槽10のフレームのガイド面などは、本発明のガイド機構を構成している。作業者が、予め印刷ローラ1の軸方向位置を設定して制御部20の軸方向位置設定器206に入力すると、コントローラ202が上述した押圧力調整の場合と同様にモータコントローラ205を介しモータ40を駆動させ、ボールネジ軸41を回転させることにより、フレーム21全体を印刷ローラ1の軸方向に作業者が設定した軸方向位置に移動させる。

【0027】このフレーム21の移動量は変位測定器43によって検出され、その信号が位置検出器アンプ207を通してコントローラ202に送られる。この信号は表示器203に表示されるので、作業者は現在のフレーム位置から印刷ローラ1の位置を常に確認することができる。コントローラ202は、上述した押圧力調整と同様に、軸方向位置設定器206の信号と変位測定器43

が検出した信号との演算差をとり、0付近になるまでモータ40を回転させる。

【0028】図3の実施形態は、印刷ローラ1の押圧力調整と軸方向位置調整とを行う制御機構について示したものであるが、この制御機構は転写ローラ2を印刷ローラ1に対して押圧力調整する機構にも同様に適用できる。ただし、軸方向位置調整機構は、転写ローラ2と印刷ローラ1とが同じフレーム21に支持されているため個々に調整する必要はない。

【0029】本発明において、印刷ローラは様々な幾何学模様毎に用意されており、異なる幾何学模様のオイルマスクを転写するときは別のローラに置き換える必要があるため、ローラの脱着は簡易にできるようになっていることが望ましい。図1、2の実施形態では、印刷ローラ1、転写ローラ2、バックアップローラ4はL状の軸配置になっていて、同一直線上に配置するようになっていないが、設置スペースが許容される場合には同一直線上に配置することができる。このように3本のローラの軸を同一直線上に配置した場合は、実施形態のように各ローラ毎に押圧力調整をするよりも、印刷ローラ1と転写ローラ2の組合せ体に対して本発明の調整機構を設置し、さらにフレームをバックアップローラ4の方向へ移動させる機構を設けて、ローラ間の押圧力調整を互いに干渉し合わないようにすることが望ましい。

【0030】このように3本のローラの軸を同一直線上に配置する場合は、互いの押圧力が過大な場合でもローラにたわみが起こりにくくし、ローラ軸方向のオイルマスクむらを低減する利点がある。本発明において、ガイド機構としては、実施形態で挙げたフレームのガイド面に対して直動転がり軸受けを使用する例示したが、この軸受けは直動スベリ軸受けであってもよい。また、磁気浮上などを利用した非接触タイプのガイドレールであってもよい。また、押圧駆動手段は、実施形態のようにモータにより送りネジを駆動させるものが好ましいが、真空対応で位置決め可能な油圧シリンダ、空圧シリンダやリニアモータなどでもよい。但し、油圧シリンダや空圧シリンダは、真空中では作動油、空気の漏れが完全に無視できないため、モータを用いることが最も適している。

【0031】また、印刷ローラ、転写ローラと押圧駆動手段との間に設ける押圧検出器としては、一般に計量用に用いられるロードセルが好ましいが、重量、力を計測できるものであれば、他のいかなる手段も使用することができる。また、印刷ローラ、転写ローラと押圧駆動手段との間に設ける弾性体としては、コイルバネが最も適しているが、板バネや硬度の低いゴムのようなものでも代用することができる。また、この弾性体に力を加えたときの変形量を測定し、近似的に押圧力検出手段とすることもできる。また印刷ローラ、転写ローラの軸支持は、球面軸受けで行うことが最も好ましいが、支持角度

自在に支持できるものであれば、例えばゴムのような弾性体を支持部材に用いるようにしてもよい。

【0032】また、本発明において、印刷ローラ、転写ローラを支持するフレームを真空槽のフレームからローラ軸方向へ移動可能に支持するガイド機構としては、押圧力調整に使用するガイド機構と同様に、直動転がり軸受けが最も好ましいが、直動スベリ軸受けや磁気浮上など非接触タイプのガイドレールであってもよい。フレームをガイド機構上に移動させる駆動手段も、押圧力調整に使用する押圧駆動手段と同様に、モータにより送りネジを駆動させるものが最も好ましいが、油圧シリンダ・空圧シリンダやリニアモータなどでも可能である。

【0033】また、その移動量を検出する変位測定器は、測定方法は問わず真空状態で安定して使えるものであればいかなるものでもよい。

【0034】

【発明の効果】上述したように、本発明の真空蒸着装置によれば、蒸着作業を中断することなく、オイルマスク形成機のローラ押圧力の調整を、作業者の技術や勘に頼らずに制御部への設定値入力のみで容易に行うことができる。また、本発明によれば、印刷ローラの軸方向位置合わせも、押圧力調整と同様に設定値を入力するのみで容易に自動調整することができる。また、本発明の真空蒸着装置の使用により、蒸着ロス、時間ロスなしに常に安定したオイルマスクを有する蒸着フィルムを製造することができる。

【図面の簡単な説明】

【図1】本発明の実施形態からなる真空蒸着装置の断面図である。

【図2】図1の装置のオイルマスク形成機部分を示す拡大図である。

【図3】図2のX-X矢視による断面を制御部と共に示した概略図である。

【図4】従来のオイルマスク形成機の断面図である。

【符号の説明】

- 1 印刷ローラ
- 2 転写ローラ
- 3 オイルノズル
- 4 バックアップローラ
- 10 真空槽
- 11 フィルム
- 20 制御部
- 31 押圧力検出器
- 32, 35 直動転がり軸受け (ガイド機構)
- 33 圧縮コイルバネ (押圧駆動手段)
- 34 ボールネジナット (押圧駆動手段)
- 36 モータ (押圧駆動手段)
- 37 ボールネジ軸 (押圧駆動手段)
- 39 直動転がり軸受け (ガイド機構)
- 40 モータ (駆動手段)

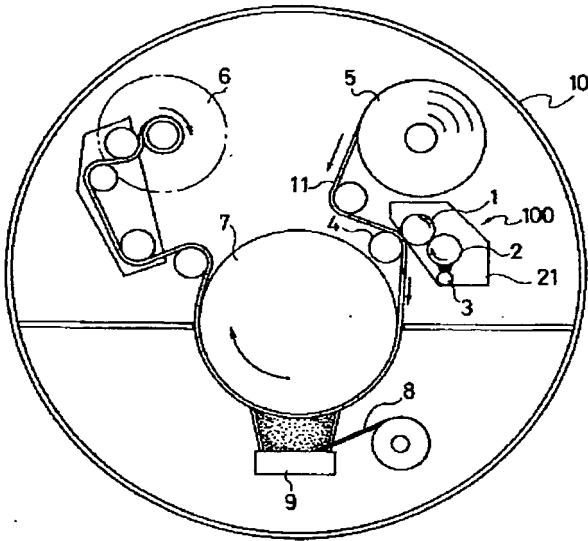
9

- 41 ボールネジ軸（駆動手段）  
 42 ボールネジナット（駆動手段）

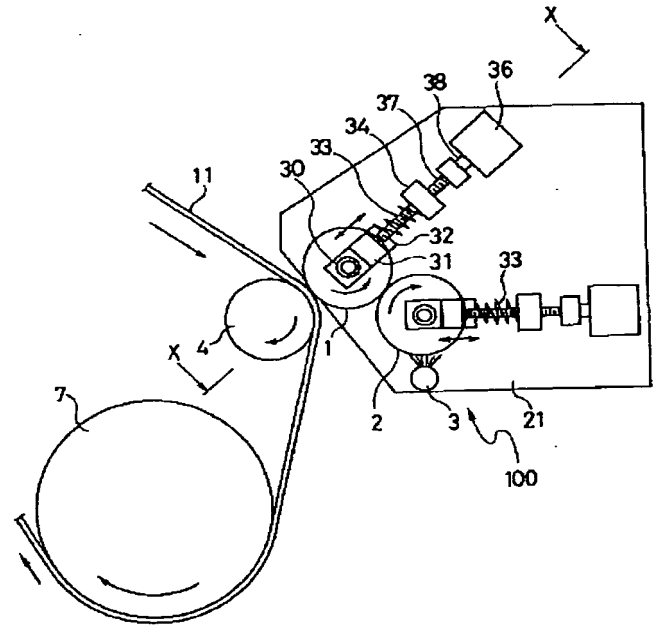
\* 43 変位測定器

\*

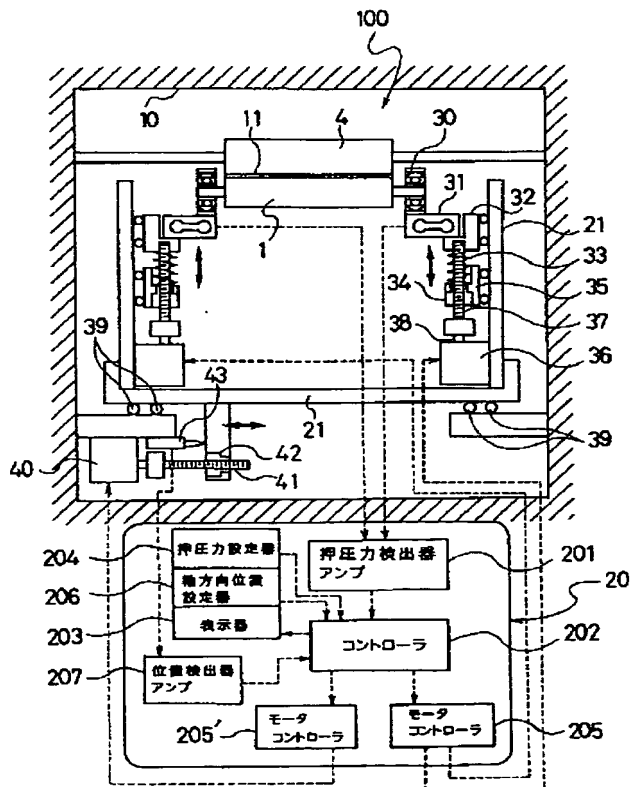
【図1】



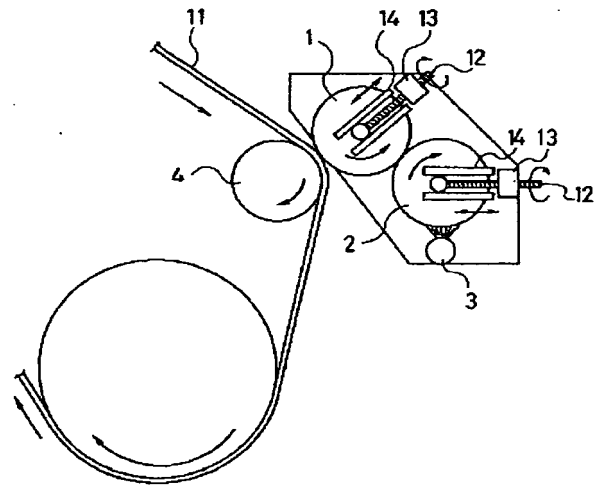
【図2】



【図3】



【図4】



# PATENT ABSTRACTS OF JAPAN

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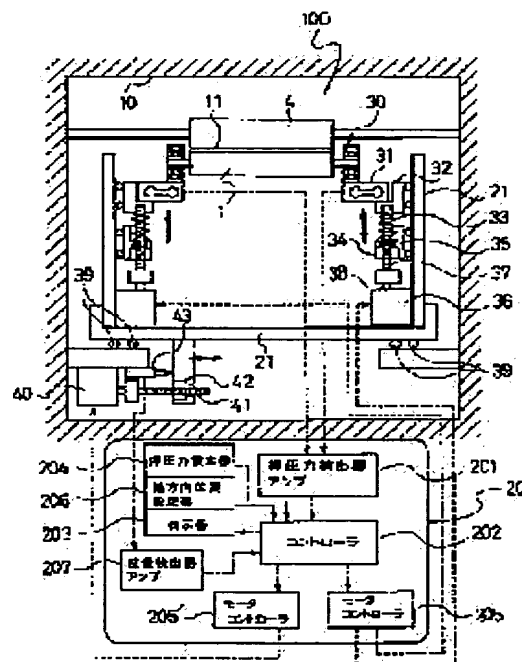
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## (54) VACUUM DEPOSITING DEVICE

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a vacuum depositing device facilitating the regulation of the pressing force of a transfer roller and a printing roller and to provide a vacuum depositing device facilitating the regulation of the relative position between the position of an oil mask of a printing roller and the position in the axial direction of a roller of a film.

**SOLUTION:** In an oil mask forming machine, pressing driving means 33, 34, 35 and 36 respectively moving a transfer roller to the direction of a printing roller 1 and moving the printing roller 1 to the direction of a backup roller 4 and a guide mechanism 32 are provided, the space among the pressing driving means, the transfer roller and the printing roller 1 is respectively provided with a pressing force detector 31, and based on the signal from the pressing force detector 31, the quantity of the pressing driving means to be driven is regulated. Moreover, driving means 40 and 41 moving frames 21 supporting both axial edge supporting parts of the printing roller 1 and the transfer roller to the direction of the roller axis and a guide mechanism 39 are provided, a displacement measuring apparatus 43 detecting the position in the direction of the roller axis of the frame 21 is provided, and based on the signal from the displacement measuring apparatus 43, the quantity in the axial direction of the frame 21 to be moved is regulated.



## LEGAL STATUS

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04.09.2002

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[Date of final disposal for application]

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[Date of extinction of right]

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**CLAIMS**

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**[Claim(s)]**

[Claim 1] Press the imprint roller for an oil imprint on a printing roller, and this printing roller is pressed to a backup roller. In the vacuum evaporation system which was run the film between this printing roller and the backup roller, and formed the oil mask molding machine which forms the oil mask used as the non-vapor-depositing section on this film The press driving means and the guide device which move said imprint roller in said direction of a printing roller, and said printing roller is moved in said direction of a backup roller, respectively are established. The vacuum evaporation system which formed the thrust detector, respectively between said press driving means and said imprint roller, and the printing roller, and prepared the control section which controls the amount of drives of said press driving means based on the thrust signal of this thrust detector.

[Claim 2] The vacuum evaporation system according to claim 1 which made the elastic body which produces compression elastic force, respectively intervene between said press driving means and said imprint roller, and said printing roller.

[Claim 3] The vacuum evaporation system according to claim 1 or 2 which supported both the axis end supporter of said imprint roller and printing roller respectively free [ include-angle adjustment ].

[Claim 4] A vacuum evaporation system given in any 1 term of claims 1-3 which support both the axis end supporter of said printing roller and imprint roller with a frame, respectively, form the position transducer which detects the location of the roller shaft orientations of said frame while establishing the driving means and the guide device which this frame is moved to roller shaft orientations, and control the movement magnitude of the shaft orientations of said frame based on the position signal of this position transducer.

[Claim 5] Press the imprint roller for an oil imprint on a printing roller, and this printing roller is pressed to a backup roller. In the vacuum evaporation system which was run the film between this printing roller and the backup roller, and formed the oil mask molding machine which forms the oil mask used as the non-vapor-depositing section on this film While establishing the driving means and the guide device which support both the axis end supporter of said printing roller and imprint roller with a frame, respectively, and this frame is moved to roller shaft orientations The vacuum evaporation system which formed the displacement measurement machine which detects the location of the roller shaft orientations of said frame, and prepared the control section which controls the movement magnitude of the shaft orientations of said frame based on the position signal of this displacement measurement machine.

[Claim 6] The manufacture approach of a vacuum evaporatio film of manufacturing the vacuum evaporatio film which uses the vacuum evaporation system of a publication for any 1 term of claims 1-5, and has a non-vapor-depositing part.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the spectacle lens made of synthetic resin manufactured by the method of manufacturing the spectacle lens made of synthetic resin which has an optical thin film, especially an antireflection film by the sputtering method at high speed, and this approach.

[0002]

[Description of the Prior Art] When creating an antireflection film to the spectacle lens made of synthetic resin, many vacuum deposition methods have been used from points, such as an ease of technique, and speed of a membrane formation rate. the multilayers by the combination of a low refractive-index layer with [ generally ] 1.50 or less low refractive index in this antireflection film, and a high refractive-index layer with 1.60 or more high refractive indexes -- or it is constituted by the monolayer which consists of a low refractive-index layer. It is known widely that the acid-resisting effectiveness better as a low refractive-index layer has a low refractive index will be acquired. For this reason, MgF<sub>2</sub> from which the stable low refractive index 1.38 is obtained by heating substrate temperature before and after 300 degrees C, and performing vacuum deposition in the antireflection film to a glass substrate It is created as a low refractive-index layer.

[0003] On the other hand, when a substrate is synthetic resin, property top substrate temperature of a substrate cannot be raised. Moreover, by the forming-membranes method do not perform substrate heating, since a film degree of hardness is inadequate and a blemish arises on the film simply, a property like [ in the case of performing heating vacuum evaporation ] is not acquired. For example, what is equal to practical use with ion assistant vacuum deposition is not obtained as indicated by JP,3-129301,A. For this reason, it sets to formation of the antireflection film to the substrate made of synthetic resin, and is SiO<sub>2</sub> as a low refractive-index layer. It uses. With this official report, it is SiO<sub>2</sub>. It is MgF<sub>2</sub> by forming the multilayers which consist of film used as a principal component. The antireflection film which has a property equivalent to monolayer has been obtained. However, even if it uses this approach, it is with a refractive index of about 1.38 MgF<sub>2</sub>. The used antireflection film of a low reflection factor like multilayers cannot be obtained, but it is MgF<sub>2</sub>. It is not a solution over the ability not to use it.

[0004] thus, the rebound ace court layer which contains an organosilicon compound in the spectacle lens made of synthetic resin beforehand in JP,4-191801,A in order to solve a point with the inadequate thermal resistance and acid-resisting effectiveness when not performing substrate heating -- preparing -- a it top -- as a high refractive-index layer -- Ta<sub>2</sub>O<sub>5</sub> TiO<sub>2</sub> etc. -- oxygen ion beam assistant vacuum deposition - - forming membranes -- as a low refractive-index layer -- SiO<sub>2</sub> Membranes are formed with the usual vacuum deposition method.

[0005] On the other hand, in recent years, membrane formation by the effective sputtering method is performed in respect of the applicability to automation, laborsaving, and a large area substrate etc. The thin film formed by this sputtering method is the film with a degree of hardness high [ as compared with the thin film by the usual vacuum deposition method, membranous pack density is high, and / without performing substrate heating, ] even when membranes are formed.

[0006] However, when it is a metal membrane, even if it serves as practical use level, in the case of other film, it is behind [ method / the sputtering method has the fault that a membrane formation rate is slow as compared with vacuum evaporation technique and ] in industrial spread, since a membrane formation rate is remarkable and slow. moreover, MgF<sub>2</sub> etc. -- when sputtering of the fluoride was carried out, it dissociated to Mg etc. and F, and in the film, since F runs short, there is a problem which big absorption of the light produces, and it had become a serious failure when applying the sputtering method to an optical

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thin film by these.

[0007]

[Problem(s) to be Solved by the Invention] The antireflection film formed in the spectacle lens made of synthetic resin as mentioned above had the high reflection factor compared with the film formed in the glass lens, namely, its acid-resisting effectiveness was low, and since the film degree of hardness was low as compared with the glass substrate which performed heating vacuum evaporatio~~no~~, it had the trouble that a blemish tends to be attached. Furthermore, when an antireflection film was constituted only from perfect derivative film, since the spectacle lens made of synthetic resin tends to be charged, it also had the trouble which is easy to become dirty by adhesion of dust etc.

[0008] This invention is made in view of such a trouble, and it is suitable as an antireflection film to the spectacle lens made of synthetic resin, and moreover, film reinforcement is high and it aims at offering how a refractive index forms the fluoride film which does not have light absorption low by the sputtering method at high speed. Moreover, in this invention, by being manufactured by this approach, it has the antistatic effectiveness and aims at offering the spectacle lens made of synthetic resin with an antireflection film to which dirt cannot adhere easily.

[0009] In order to attain the above-mentioned purpose, invention of claim 1 Granularity MgF<sub>2</sub> [ with a particle size of 0.1–10mm ] Introducing one or more sorts of gas which considered as the film raw material and was chosen from oxygen, nitrogen, or hydrogen in a vacuum tub Alternating current power is switched on and it is MgF<sub>2</sub>. The plasma is generated upwards and it is MgF<sub>2</sub> by this plasma. While holding a front face in temperature of 450–800 degrees C MgF<sub>2</sub> It is MgF<sub>2</sub> by carrying out sputtering with the cation of said introductory gas. Skip at least a part in the state of a molecule, and it is made to come out, and is MgF<sub>2</sub> of this molecule condition. It is characterized by forming the film on the substrate of a spectacle lens.

[0010] By the conventional sputtering method, when ion collided with a target, it is necessary to cut the interatomic bond in a target, and the atom needed to be made to jump out of a target, and since spending a part of energy of the accelerated ion in cutting an interatomic bond, it had the fault that spatter yield became low and as a result a membrane formation rate became slow. On the other hand, in this invention, since bonding strength is weakened beforehand and ion is made to collide with a target in this condition by raising the temperature of a film raw material, the great portion of energy of the accelerated ion can be used for sputtering. For this reason, spatter yield becomes high and, as a result, can make a membrane formation rate remarkably quick as compared with a conventional method.

[0011] Moreover, to an interatomic bond going out and an atom beginning to skip from a target, by raising the temperature of a film raw material, the strong part of bonding strength and a weak part are formed by heat vibration, and the case where the gestalt of the particle which this begins to skip serves as a molecule arises in this invention by the conventional sputtering method. A molecule here contains in the shape not only of a single molecule but a cluster the many child who forms the aggregate. And it is possible that the gestalt of the molecule which it begins to skip from a target becomes almost the same as the evaporation molecule by heat.

[0012] In this invention, making an electrode into negative potential and carrying out sputtering of the film raw material with a cation is based on the same principle as the RF spatter generally known by impressing an alternating current to the electrode which laid the film raw material. An alternating current here also contains the 13.56MHz so-called RF and the inside cycle of several 10kHz. In this invention, since the plasma occurs on an electrode by impressing an alternating current to the electrode which laid the film raw material in order to perform sputtering, a film raw material can be heated by this plasma. Especially, that heat conduction is bad and when a film raw material is granularity, and electric field and a magnetic field concentrate on the edge section which exists so much, it can heat easily.

[0013] In addition, at this time, since the magnitude of granulation will soar within a vacuum tub and will serve as particle if it is too small not much, its direction with a particle size of 0.1mm or more is good, and its 0.5mm or more is desirably good. Since the edge section decreases and the effectiveness by concentration of electric field and a magnetic field becomes small on the other hand while adiabatic efficiency will decrease, if granulation is too large, 5mm or less is desirably good the particle size of 10mm or less. The magnitude of granulation and a configuration do not necessarily need to be uniform.

[0014] In the case of an optical application, it is desirable for the light absorption of a thin film to be small generally. Therefore, it is more desirable to become molecule-like rather than the gestalt of the particle which it begins to skip dissociates scatteringly and becomes atom-like, when a film raw material is the same presentation as a desired thin film. It is because what was dissociated does not necessarily return as former. It became clear wholeheartedly about this that it depended for the gestalt of the particle which it

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begins to skip on the type of gas introduced at the time of sputtering as a result of research. It can be made to begin to skip the gas containing oxygen, nitrogen, hydrogen, or these in the state of a molecule to what is easy to tear apart the particle which begun to skip inert gas, such as Ar generally used to sputtering, in the shape of an atom, without tearing apart the particle which it begins to skip. Since it is such, when manufacturing an optical thin film, it is good to introduce the gas which contains any one of oxygen, nitrogen, or the hydrogen at least especially.

[0015] In addition, the gas containing oxygen, nitrogen, hydrogen, or these does not almost have combining a film raw material with a film raw material only by carrying out sputtering. Therefore, it is thought that the optical thin film manufactured by doing in this way has the almost same presentation as the case where heat a film raw material, evaporated it and the film is made to form on a substrate.

[0016] MgF<sub>2</sub> especially useful as an optical thin film In the case of used sputtering, if the skin temperature of a target is 450 degrees C or more, the membrane formation rate can fully be raised. On the other hand, if it becomes 800 degrees C or more, the vapor pressure of a film raw material will rise to the pressure near introductory gas, an evaporation molecule will come to reach a substrate as it is, and mere vacuum evaporatio and a mere difference will become small. In vacuum evaporatio, unlike the case of sputtering, abrasion-proof nature becomes low. MgF<sub>2</sub> In vacuum evaporatio, if a substrate is not heated to about 300 degrees C, abrasion-proof nature becomes remarkably low and becomes what cannot bear practical use, but the high film of abrasion-proof nature is obtained by keeping the skin temperature of a target at 800 degrees C or less. Especially, it is MgF<sub>2</sub> under membrane formation. By making temperature into 500 degrees C or more, the film with more little absorption can be obtained and a highly efficient antireflection film with more high abrasion-proof nature can be formed by making it 700 degrees C or less. As gas to introduce, when economical efficiency, availability, safety, etc. are taken into consideration, oxygen or especially nitrogen is desirable.

[0017] Thus, the manufactured optical thin film will not almost have absorption in stoichiometry in a visible region soon, and the refractive index will become about 1.38. Therefore, this optical thin film has acid-resisting effectiveness sufficient also by the monolayer, and can use it as an antireflection film to the lens for glasses containing sunglasses, goggles, etc.

[0018] Since it is not necessary to heat a substrate in this invention, about the material of the applicable spectacle lens made of synthetic resin, there is no limit in any way. Therefore, it is applicable to any synthetic resin, such as polycarbonate system resin besides diethylene-glycol bisallyl carbonate (trade name "CR-39"), polyurethane system resin, polystyrene system resin, polyvinyl chloride system resin, and acrylic resin.

[0019] Invention of claim 2 is granularity MgF<sub>2</sub> [ with a particle size of 0.1-10mm ]. Introducing one or more sorts of gas which considered as the film raw material and was chosen from oxygen, nitrogen, or hydrogen in a vacuum tub High-frequency power is switched on and it is MgF<sub>2</sub>. The plasma is generated upwards and it is MgF<sub>2</sub> by this plasma. While holding a front face in temperature of 450-800 degrees C MgF<sub>2</sub> It is MgF<sub>2</sub> by carrying out sputtering with the cation of said introductory gas. Skip at least a part in the state of a molecule, and it is made to come out, and is MgF<sub>2</sub> of this molecule condition. The process which forms the film on the substrate of a spectacle lens, It is characterized by having the process which forms the film which consists of a metallic oxide or a silicon oxide, and forming an antireflection film according to these processes on said substrate.

[0020] By this invention, it is an antireflection film on the spectacle lens made of synthetic resin in claim 1 MgF<sub>2</sub> By considering as the multilayer configuration combined with the metallic oxide and/or the silicon oxide, the film with the more high acid-resisting effectiveness can be formed.

[0021] Invention of claim 3 is characterized by said metallic oxide or a silicon oxide using Zr, Ti, Ta, aluminum, In, Sn, Si, or the plurality of them as a principal component in invention of claim 2.

[0022] It sets to claim 2 and is MgF<sub>2</sub>. The highly efficient antireflection film excellent in the stable optical property and endurance can be formed by using Zr, Ti, Ta, aluminum, In, Sn, Si, or the plurality of them as a principal component for the metallic oxide or silicon oxide to combine. A high antistatic operation can be acquired by using the oxide film which uses as a principal component either [ at least ] In which is not a dielectric, or Sn especially, or the silicon monoxide film as one layer of multilayers.

[0023] Invention of claim 4 is characterized by forming said metallic oxide or a silicon oxide by the magnetron sputtering method in invention of claim 2.

[0024] MgF [ in / by this invention / invention of claim 2 ] 2 By forming the metallic oxide or silicon oxide to combine by the magnetron sputtering method, the highly efficient antireflection film excellent in endurance, such as high abrasion nature, and productivity can be formed.

[0025] Invention of claim 5 is the spectacle lens made of synthetic resin manufactured by one manufacture

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approach of one to claim 4 terms.

[0026]

[Embodiment of the Invention]

(Gestalt 1 of operation) Drawing 1 shows the membrane formation equipment used for the gestalt 1 of operation. The substrate 2 is formed above the vacuum tub 1 possible [ rotation ]. MgF<sub>2</sub> with a particle size of 1–5mm which is a film raw material Granulation 3 is put into the pan 4 made from a quartz, and is laid on the magnetron cathode 5 with a diameter of 4 inches (about 100mm). The cathode 5 is connected with 13.56MHz RF generator 7 through the matching box 6. Moreover, in order to keep the temperature of a cathode 5 constant, in the inferior surface of tongue of a cathode, the cooling water 8 which controlled water temperature at 20±0.5 degrees C is poured. Gas inlets 9 and 10 are inserted in the side face of the vacuum tub 1, and the shutter 11 is arranged between the cathode 5 and the substrate 2. Eccentricity of 100mm and the revolving shaft of a substrate 2, and the medial axis of a cathode 5 is carried out for the distance between a cathode 5 and a substrate 2 in the distance of 50mm.

[0027] The substrate 2 which is the lens made of urethane system synthetic resin of a refractive index 1.60 is set, and the inside of the vacuum tub 1 is exhausted to the degree of vacuum of 7x10 to 5 Pa. Then, O<sub>2</sub> Gas is introduced from a gas inlet 9 to 4x10 to 1 Pa. Power is supplied to the magnetron cathode 5 from RF generator 7, and the plasma is generated. MgF<sub>2</sub> Granulation 3 is heated by this plasma, and while being held at the temperature which balanced with the cooling power by the cooling water 8 under a cathode, sputtering of it is carried out.

[0028] It is MgF<sub>2</sub> on a substrate 2 by rotating a substrate 2 and opening a shutter 11 here. The film is formed. This optical thickness closes a shutter 11 after the time amount used as 130nm. When the wavelength of the plasma emission spectrum under membrane formation is inspected and injection power becomes more than 400W, they are a MgF molecule and MgF<sub>2</sub> besides Mg atom. Luminescence from a molecule was accepted and it was checked that some film raw materials [ at least ] have skipped in the state of a molecule.

[0029] Drawing 2 shows the property Fig. [ rate / on a substrate 2 / the skin temperature of the granulation 3 at the time of changing injection power, and / membrane formation ] of change, a characteristic curve A is skin temperature and a characteristic curve B is a membrane formation rate. In addition, the skin temperature of granulation 3 was measured with the infrared radiation thermometer. When injection power becomes more than 400W, it turns out that skin temperature rises at about 450 degrees C or more, and the membrane formation rate is quick rapidly. On the other hand, if injection power is set to 800W, skin temperature will rise even at about 800 degrees C.

[0030] As a result of EPMA's analyzing the film which injection power formed between 400W and 800W, Mg:F is 1:1.8–1.95 and the amount of the presentation ratio of F has increased [ the one where injection power is larger ]. O<sub>2</sub> (oxygen) introduced as process gas has also checked hardly existing in the film. Moreover, although association with F was accepted for the condition in the inside of the film of Mg as a result of FT-IR's analyzing, association with oxygen was not accepted. Furthermore, as a result of XRD's analyzing, crystallinity was low and the clear peak was not accepted.

[0031] Next, a membranous abrasion-proof nature test and a membranous adhesion force test were performed. An abrasion-proof nature test is 2 1cm. 10 stroke \*\*\*\* steel wool test performed the coat side by the #0000 mesh steel wool to which the load of 1kg of hits was applied. an adhesion force test is in every direction with a knife in the cutting plane line which reaches an antireflection film at the base material of 1mm spacing -- respectively -- 11 -- forming -- 1mm<sup>2</sup> The cross-cut test which creates 100 measure, sticks a cellophane tape on it, removes rapidly, and counts the number of the measure eyes which separated performed. In addition, evaluation of a steel wool test was performed as follows.

A: B to which a blemish is attached slightly : a blemish is attached somewhat (level better than CR-39 which gave the rebound ace court).

C: A blemish is attached somewhat (CR- which gave the rebound ace court it is 39 and equivalent level and is satisfactory practically bordering level).

D: E with very many blemishes : [0032] which membranous peeling produces As a result of performing a cross cut adhesion test about the film of the gestalt of this operation, exfoliation of the film was not produced on condition that any. Moreover, by the result of a steel wool test, in the thing below injection power 500W, it became B ranks A ranks and 500–700W, and became C rank by 800W. By the thing of 900W, it became a pan with E ranks. Thus, when injection power was less than [ 800W ], even if it did not prepare the rebound ace court layer of an organic system, sufficient abrasion-proof nature was able to be obtained.

[0033] next, the spectrum manufactured according to the gestalt of this operation -- the measurement

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result of a refractive index  $n$  and an absorption coefficient  $k$  by ellipsometry is shown in drawing 12 - drawing 16. Drawing 12 shows a refractive index and drawing 13 - drawing 16 show change of the absorption coefficient  $k$  (the injection power at this time is 700W, 600W, 500W, and 400W about, respectively) in case the skin temperature of granulation 3 is 700 degrees C, 600 degrees C, 500 degrees C, and 450 degrees C, respectively. it is shown in drawing 13 - drawing 16 -- as -- the absorption coefficient  $k$  in a visible region (400-700nm) -- a case with granulation 3 skin temperature of 450 degrees C -- about 0.02 or less -- other than this -- coming out -- it can also creep -- it has become  $1.6 \times 10$  to three or less, and has level usable as low refractive-index optical film for spectacle lenses.

[0034] In addition, in order to raise the permeability of a spectacle lens, it turns out that it is more desirable to make skin temperature of granulation 3 into 500 degrees C or more. Moreover, the refractive index  $n$  became about 1.38 like drawing 12, also when membranes were formed on condition that any.

[0035] Drawing 4 shows the measurement result of the spectral reflectance of the antireflection film of the gestalt of this operation. The reflection factor is falling to 0.8% or less on main wavelength, and has the acid-resisting property good as a monolayer antireflection film. When the range of the particle size of granulation was 0.1mm - 10mm, the same result was obtained, and it was satisfactory in any way.

[0036] O<sub>2</sub> to introduce In any range of  $5 \times 10$  to 2 Pa -  $5 \times 100$  Pa, the pressure of gas was able to obtain the antireflection film which has a good optical property and endurance, although required injection power differed somewhat.

[0037] (Example 1 of a comparison) MgF<sub>2</sub> It is MgF<sub>2</sub> instead of granulation 3. The result of having conducted the same experiment as the gestalt 1 of operation is shown in drawing 3 using a sintered compact. A is skin temperature and B is a membrane formation rate. Since it is hard to be heated unlike the case of granulation even if it enlarges injection power when a sintered compact is used, temperature hardly rises. That is, it is in the condition of sputtering usually performed, and a membrane formation rate is remarkably slow and is not practical. For example, although the membrane formation time amount from which optical thickness is set to 130nm with the gestalt 1 of operation in the case of injection power 600W was 18 seconds, 11 minutes will be required if it is going to obtain the same thickness in the example 1 of a comparison.

[0038] Moreover, an absorption coefficient is 0.1 or more in a visible region, and the thin film manufactured in the example 1 of a comparison is impossible for using for an optical application. Furthermore, it was checked that the presentation ratio of the thin film manufactured in the example 1 of a comparison is 1:1.5-1.7, and is [ Mg:F ] considerably insufficient of the amounts of F. Moreover, it was checked that the crystallinity is a little high.

[0039] (Example 2 of a comparison) It is MgF<sub>2</sub> by the vacuum deposition method widely used in this example of a comparison. The film was formed. When a substrate was not heated, membranes were formed on two kinds of conditions at the time of heating at 300 degrees C. In [ both of ] conditions, it was as small as ten to three or less, and Mg:F of the membranous presentation ratio was 1:1.9-2.0. When a substrate was heated at 300 degrees C, crystallinity had become, abrasion-proof nature was also set high to practical use level, but when membranes were formed to the spectacle lenses made of synthetic resin (i.e., when not heating a substrate), since it was low, abrasion-proof nature was as remarkable as E ranks and crystallinity was low, practical use level did not become.

[0040] (Gestalt 2 of operation) The same equipment as the gestalt 1 of operation is used, and it is N<sub>2</sub> from a gas inlet 9. Up to  $1 \times 10$  to 1 Pa, Ar was introduced from the gas inlet 10 up to  $3 \times 10$  to 2 Pa. There were a little few rises of temperature as compared with the gestalt 1 of operation, and target skin temperature rose [ injection power ] at 450 degrees C or more more than by 500W. As a result of forming membranes on a substrate in injection power 650W, and membrane formation time amount 21 seconds, the membranous spectral reflectance became completely the same as drawing 4. The light absorption in a visible region suited practical use level enough at 1% or less. As a result of performing the same trial as the gestalt 1 of operation, there was no exfoliation of the film at a cross cut adhesion test, and the result of a steel wool trial was also B ranks.

[0041] (Gestalten 3 and 4 of operation) Drawing 17 shows the membrane formation equipment used for the gestalt of this operation. The batch has connected 2 of the vacuum tub of the configuration as the gestalt 1 of operation with this same equipment tubs with the gate valve 12. A substrate can convey between the vacuum tub 1 and 1' according to a conveyance device (illustration abbreviation). In the vacuum tub 1, it was referred to as injection power 600W, and membranes were formed by the same approach as the gestalt 1 of operation. In vacuum tub 1', metal plates, such as Ta and Zr, were used as a target. The magnetron cathode is connected to DC power supply 13. gas inlet 9' to O<sub>2</sub> gas inlet 10' to Ar -- introducing -- the DC reactivity magnetron sputtering method -- Ta<sub>2</sub>O<sub>5</sub> and ZrO<sub>2</sub> etc. -- the high refractive-index film is

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formed on substrate 2'.

[0042] the diethylene-glycol bisallyl carbonate (CR-39) substrate which gave the rebound ace court of an organic system as a substrate 2 -- using -- MgF<sub>2</sub> and Ta 2O<sub>5</sub> of the thickness of respectively the request by the vacuum tub 1 and 1' on this substrate 2, and ZrO<sub>2</sub> etc. -- by forming by turns, the antireflection film was formed and the spectacle lens made of synthetic resin was created. A film configuration is shown in Table 1 and the spectral characteristic of the gestalten 3 and 4 of operation is shown in drawing 5 and drawing 6, respectively. A reflection factor is 0.5% or less throughout the wavelength of 400-700nm which is a visible region, and the antireflection film of the gestalten 3 and 4 of operation has the extremely excellent property. Moreover, there is no exfoliation of the film at a cross cut adhesion test, and the result of a steel wool trial is also as good as B ranks.

[0043] (Gestalt 5 of operation) With the gestalt of this operation, the same equipment as the gestalt 2 of operation was used. In the vacuum tub 1, ITO (what added SnO<sub>2</sub> 5% by the weight ratio to In 2O<sub>3</sub>) was used as a target. In the vacuum tub 1, it was referred to as injection power 500W, and membranes were formed by the same approach as the gestalt 1 of operation. At vacuum tub 1', it is O<sub>2</sub> from a gas inlet 9. Ar was introduced from gas inlet 10', and the ITO film was formed on the substrate by the DC reactivity magnetron sputtering method.

[0044] As a substrate 2, by forming MgF<sub>2</sub> of desired thickness, and ITO by turns by the vacuum tub 1 and 1' on this substrate 2, respectively, the antireflection film was formed and the spectacle lens made of synthetic resin was created using the diethylene-glycol bisallyl carbonate (CR-39) substrate which gave the rebound ace court of an organic system. A film configuration is shown in Table 1 and the spectral characteristic is shown in drawing 7. The antireflection film serves as a property which whose reflection factor is about 0.5% or less, and was extremely excellent in the wavelength of 420-700nm, as shown in drawing 7. With the gestalt of this operation, since ITO which is not a dielectric as some antireflection films was used, the spectacle lens which is excellent in conductivity, therefore does not have adhesion of the dust by electrification was able to be obtained. Moreover, there is no exfoliation of the film at a cross cut adhesion test, and the result of a steel wool trial is also as good as B ranks.

[0045] (Gestalten 6 and 7 of operation) The spectacle lens made of synthetic resin with an antireflection film was created using the almost same equipment as the gestalt 2 of operation. However, the cathode 5 of vacuum tub 1' is three pieces. Si which doped metals, such as Ta, Zr, and aluminum, and boron to this cathode 5, and gave conductivity was used. In the vacuum tub 1, it was referred to as injection power 400W, and membranes were formed by the same approach as the gestalt 1 of operation. At vacuum tub 1', it is O<sub>2</sub> from a gas inlet 9. Ar is introduced from gas inlet 10', and a metal or the silicon oxide film is formed on a substrate 2 by DC reactive-sputtering method.

[0046] Using the diethylene-glycol bisallyl carbonate (CR-39) substrate which has not given the rebound ace court as a substrate 2, MgF<sub>2</sub> and the desired metal, or desired silicon oxide of thickness was formed by turns by the vacuum tub 1 and 1' on this substrate, respectively, the antireflection film was formed, and the spectacle lens made of synthetic resin was created. A film configuration is shown in Table 1 and the spectral characteristic of the gestalten 6 and 7 of operation is shown in drawing 8 and 9, respectively. The antireflection film of the gestalten 6 and 7 of operation serves as a property which a reflection factor is 0.25% or less, and was extremely excellent in the wavelength of 420-700nm with the gestalt 7 of 0.5% or less, especially operation.

[0047] With the gestalt of these operations, since the thickness of antireflection film each class was constituted only from  $\lambda/4$  ( $\lambda = 520\text{nm}$ ) of multiples, thickness control is easy and dispersion in an appearance color with it is also small. [ there is little dispersion in thickness, therefore very important as an antireflection film for spectacle lenses ] Moreover, there is no exfoliation of the film at a cross cut adhesion test, and the result of a steel wool trial is also as good as B ranks.

[0048] (Gestalten 8 and 9 of operation) On the diethylene-glycol bisallyl carbonate (CR-39) substrate which gave the rebound ace court of an organic system, the film of three layers is prepared beforehand, the same equipment as the gestalt 1 of operation on it is used, and it is MgF<sub>2</sub>. The film was formed and the spectacle lens with an antireflection film of a total of four layers was created. In the vacuum tub 1, it was referred to as injection power 500W, and membranes were formed by the same approach as the gestalt 1 of operation. A film configuration is shown in Table 1 and the spectral characteristic of the gestalten 8 and 9 of operation is shown in drawing 10 and 11, respectively. The antireflection film of the gestalten 8 and 9 of operation serves as a property which a reflection factor is 0.3% or less, and was extremely excellent in the wavelength of 420-700nm with the gestalt 9 of about 1% or less, especially operation. Moreover, there is no exfoliation of the film at a cross cut adhesion test, and the result of a steel wool trial is also as good as B ranks.

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[0049]

[Table 1]

	実施の形態						
	3	4	5	6	7	8	9
膜構成	MgF <sub>2</sub> 128 nm	MgF <sub>2</sub> 132 nm					
	ZrO <sub>2</sub> 275 nm	Ta <sub>2</sub> O <sub>5</sub> 286 nm	MgF <sub>2</sub> 130 nm	MgF <sub>2</sub> 130 nm	MgF <sub>2</sub> 130 nm	MgF <sub>2</sub> 120 nm	MgF <sub>2</sub> 130 nm
	MgF <sub>2</sub> 47 nm	MgF <sub>2</sub> 53 nm	ITO 282 nm	Ta <sub>2</sub> O <sub>5</sub> 260 nm	Ta <sub>2</sub> O <sub>5</sub> 260 nm	TiO <sub>2</sub> 275 nm	Ta <sub>2</sub> O <sub>5</sub> 280 nm
	ZrO <sub>2</sub> 39 nm	Ta <sub>2</sub> O <sub>5</sub> 48 nm	MgF <sub>2</sub> 44 nm	SiO <sub>2</sub> 130 nm	Al <sub>2</sub> O <sub>3</sub> 130 nm	SiO <sub>2</sub> 40 nm	SiO <sub>2</sub> 130 nm
	MgF <sub>2</sub> 28 nm	MgF <sub>2</sub> 48 nm	ITO 33 nm	MgF <sub>2</sub> 130 nm	SiO <sub>2</sub> 130 nm	TiO <sub>2</sub> 30 nm	SiO <sub>2</sub> 130 nm
基板	CR39	CR39	CR39	CR39	CR39	CR39	CR39

[0050]

[Effect of the Invention] According to this invention, the fluoride film suitable as an antireflection film of the spectacle lens made of synthetic resin which does not have light absorption low [ a refractive index ] can be formed by the sputtering method at high speed, and, thereby, the spectacle lens made of synthetic resin with an antireflection film can be obtained.

[0051] Moreover, according to this invention, film reinforcement can be high, a refractive index can form the fluoride film which does not have light absorption low by the sputtering method at high speed, and, thereby, the spectacle lens made of synthetic resin with an antireflection film can be obtained.

[0052] Furthermore, according to this invention, it has the antistatic effectiveness and the spectacle lens made of synthetic resin with an antireflection film to which dirt cannot adhere easily can be obtained.

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the sectional view of the vacuum evaporation system which consists of an operation gestalt of this invention.

[Drawing 2] It is the enlarged drawing showing the oil mask molding machine part of the equipment of drawing 1 .

[Drawing 3] It is the schematic diagram having shown the cross section by the X-X view of drawing 2 with the control section.

[Drawing 4] It is the sectional view of the conventional oil mask molding machine.

[Description of Notations]

- 1 Printing Roller
- 2 Imprint Roller
- 3 Oil Nozzle
- 4 Backup Roller
- 10 Vacuum Tub
- 11 Film
- 20 Control Section
- 31 Thrust Detector
- 32 35 Direct-acting rolling bearing (guide device)
- 33 Compression Spring (Press Driving Means)
- 34 Ball Screw Nut (Press Driving Means)
- 36 Motor (Press Driving Means)
- 37 Ball Screw Shaft (Press Driving Means)
- 39 Direct-acting Rolling Bearing (Guide Device)
- 40 Motor (Driving Means)
- 41 Ball Screw Shaft (Driving Means)
- 42 Ball Screw Nut (Driving Means)
- 43 Displacement Measurement Machine

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